

view of Gemba et al. (US 4,925,461). Reconsideration of claims 1-4 is respectfully requested.

Discussion of Rejections under 35 U.S.C. 103(a)

In last Response, Applicants argue that one feature of this invention not disclosed in the prior art is that the purity of the nitrogen gas product ranges from 99% to 99.999% with the regeneration of the adsorbent being conducted under atmospheric pressure. In response thereto, the Office Action argued in Page 3 that Gemba et al. also aims to achieve 99.99% pure nitrogen gas, and stated: *"Also Example 8 of Gemba et al. ('461), shows that with depressurization down to atmospheric pressure, a nitrogen product gas can be obtained which contains "a residual oxygen concentration of 730ppm", which is approximately 99.9993% pure nitrogen gas."*

However, Applicants respectfully point out that a residual oxygen concentration of 730ppm (730/1,000,000) should correspond to a nitrogen purity of **99.93%** ($1 - 730/1,000,000 = 999,270/1,000,000 = 99.927/100 \sim 99.93\%$), but not 99.9993% that corresponds to 7.3ppm. Applicants have also noticed that the nitrogen purity (**99.93%**) in Example 8 is the highest one that can be achieved in the examples of Gemba et al., while **99.99% pure nitrogen is merely the aim of Gemba et al. that cannot be supported by the experiments of the Examples.** Furthermore, the purity of 99.99% is still lower than the purity of 99.999% mentioned in claims 1 and 4.

Therefore, the feature that the purity of the nitrogen product ranges from 99% to 99.999% in this invention cannot be anticipated in view of Gemba et al. This is quite reasonable in theory because *the characteristics of the CMS used in Gemba et al. are not specified as in this invention*, and the characteristics of the CMS absolutely affects the performance of the PSA

process.

Moreover, Applicants would like to stress the features of independent claims 1 and 4 again, including: *a period "TO" needed for the carbon molecular sieve to adsorb an oxygen amount of 50% of a saturated oxygen adsorption amount starting from the beginning of oxygen supply is 5-10 seconds and a period "TN" needed for the carbon molecular sieve to adsorb a nitrogen amount of 50% of a saturated nitrogen adsorption amount starting from the beginning of nitrogen supply is larger than "TO" by more than 41 times*, and the purity of the nitrogen gas product ranges from 99% to 99.999% with the regeneration of the adsorbent being conducted under atmospheric pressure. The features are recited in independent claims 1 and 4 as follows, marked with underlines:

1. A method for producing nitrogen using a pressure swing adsorption (PSA) method with air as a raw material, comprising:

having the air contact with an adsorbent that comprises a carbon molecular sieve selectively adsorbing oxygen to produce nitrogen with a purity ranging from 99% to 99.999% by using the pressure swing adsorption (PSA) method that conducts regeneration of the adsorbent under atmospheric pressure, wherein

a period "TO" needed for the carbon molecular sieve to adsorb an oxygen amount of 50% of a saturated oxygen adsorption amount starting from the beginning of oxygen supply is 5-10 seconds, and a period "TN" needed for the carbon molecular sieve to adsorb a nitrogen amount of 50% of a saturated nitrogen adsorption amount starting from the beginning of nitrogen supply is larger than "TO" by more than 41 times.

4. An apparatus for producing nitrogen with a purity ranging from 99% to 99.999% using air as a raw material, comprising:

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in said at least one adsorbing column, an adsorption step and a depressurization regeneration step are switched alternatively and periodically to implement a pressure swing adsorption (PSA) process, wherein the adsorption step comprises conducting a raw air compressively into the adsorbing column, and the depressurization regeneration step comprises releasing a compressed gas under atmospheric pressure after the adsorption step; and

the adsorbent is a carbon molecular sieve that selectively adsorbs oxygen, which adsorbs an oxygen amount of 50% of a saturated oxygen adsorption amount with a period "TO" of 5-10 seconds starting from the beginning of oxygen supply, and adsorbs a nitrogen amount of 50% of a saturated nitrogen adsorption amount with a period "TN" starting from the beginning of

nitrogen supply, wherein TN is larger than TO by more than 41 times.

Auvil et al. fail to teach or suggest the aforementioned features of this invention. Auvil et al. teach and suggest that a CMS preferably has a high oxygen volumetric capacity for higher recovery and productivity in PSA, as described in col. 5, lines 2-7: *"we have discovered that the exceptionally **high oxygen volumetric capacity** of the CMS enables higher recovery and productivity in PSA than commercial CMS, even if the high capacity CMS has a slower oxygen uptake rate and a lower O_2/N_2 kinetic selectivity than the commercial CMS"*. Obviously, *Auvil et al. are not concerned about the purity of the nitrogen gas product and consider that the oxygen uptake rate and the O_2/N_2 kinetic selectivity are not important.*

Auvil et al. even *teach away* to use a CMS having an O_2/N_2 kinetic selectivity higher than 41 as in this invention, because *the effect of increasing the O_2/N_2 kinetic selectivity from 36 to 72 is small* as compared with the effect of increasing the oxygen volumetric capacity by only 50% in Auvil et al. As described in Example 60 of Auvil et al.: *"The process improvements resulting from increasing selectivity by 100% are **only about 60%** of those obtained by increasing capacity by only 50% (Example 58)"* (col. 26, lines 6-9). Therefore, one skilled in the art is not motivated to increase the O_2/N_2 kinetic selectivity of the CMS from 36 to 72, i.e., to use a CMS having an O_2/N_2 kinetic selectivity higher than 41, in view of Auvil et al.

Moreover, the CMS mentioned in Examples 58-61 of Auvil et al. is simply a theoretical CMS that does not exist in real world, since it is impossible to have the same N_2 uptake rate as the O_2 uptake rate is doubled (the O_2 uptake time is decreased from 31s in Examples 57-59 to 15.5s in Example 60, while the N_2 uptake time is 1127s through Examples 57-60). According to

the results of Applicants' experiments shown in Table 1, *the N_2 uptake rate changes almost proportionally to the O_2 uptake rate*. Therefore, the CMS in Examples 58-61 does not exist in real world, and Example 60 is not accomplishable and cannot be a prior method of this invention.

Furthermore, *Auvil et al. does not teach or suggest that the CMS in Example 60 can be used to produce a nitrogen product having a purity of 99%-99.999%*. This is also quite reasonable in theory since it is impossible to theoretically estimate the exact purity of a nitrogen gas product from the characteristic values of the CMS used for producing the nitrogen gas product.

In summary, Auvil et al. *teach away* to use a CMS having an O_2/N_2 kinetic selectivity higher than 41 as in this invention, and the method of Gemba et al. *cannot* produce nitrogen of 99%-99.999% in purity with a regeneration step under atmospheric pressure. Moreover, Auvil et al. cannot anticipate the purity of the nitrogen gas obtained by using their theoretical CMA, while Gemba et al. do not suggest any characteristic index (e.g., the ranges of TO or TN/TO in this invention) that an ideal CMS should have.

Accordingly, at least the features of *"using a CMS having a TO of 5-10 seconds and a TN/TO ratio higher than 41"* and *"producing nitrogen of 99%-99.999% in purity with a regeneration step under atmospheric pressure"* are not taught or suggested in the combination of Auvil et al. and Gemba et al.

For at least the reasons mentioned above, Applicants respectfully submit that independent claims 1 and 4 patently define over the prior art.

For at least the same reasons mentioned above, Applicants respectfully submit that claims 2-3 dependent from claim 1 also patently define over the prior art.

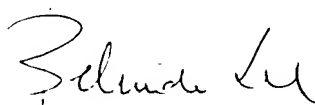
CONCLUSION

For at least the foregoing reasons, it is believed that pending claims 1-4 are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

Respectfully submitted

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